Mechanical & Industrial Engineering
UNIVERSITY OF TORONTO

MIE498H1: Research Thesis 2023-2024

Supervisor	Patrick Lee
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Number of Positions	1
Open to	Mechanical Engineering Students
Term Offered	Full-Year (Y)
Research Area	Materials
Research Topic	Fabricating Hierarchically Structured Carbon Aerogels from Sustainable Biomaterials

Project Description

Carbon aerogels are lightweight materials with densities near 0.01 - 0.4 g/cm3, high specific surface areas of 30 - 600 m2/g, and possess an interconnected open-cell structure, among other desirable properties. As such, carbon aerogels have found use in applications ranging from energy storage to water purification. Unfortunately, carbon aerogels are often fabricated from materials like melamine sponges, with poor control of micro, meso, and nanopore structure. As well, silica-based precursors are often used to fabricate carbon aerogels, but these siliceous materials are challenging to remove in the final product. In this study, we aim to replace these materials by fabricating an aerogel template from a sustainable bio-based polymer. We then aim to infiltrate the pores of this biopolymer template with a biomaterial capable of coating the biopolymer aerogel. This coated structure can be subject to carbonization, yielding a carbonaceous layer along the biopolymer aerogel template. Solution blending and simple thermal treatments will be used to fabricate intricately structured biopolymer aerogel templates and coated templates. Controlled carbonization will be used to provide the final carbonaceous structure comprising the carbon aerogel, as well as eliminate the biopolymer template. The schematic in Figure 1 shows the final target of this project which is to fabricate a carbon aerogel with tunable pore structure from sustainable bio-materials. The student will aim to explore the range of possible pore structures and morphologies through varying precursor composition, coating thickness, and carbonization conditions.

Additional Information	N/A
Application Instructions	Please submit CV, unofficial transcript, to Prof. Patrick Lee (patricklee@mie.utoronto.ca)